131st Meeting of the South Carolina Aquatic Plant Management Council

Attendance:

Council Members: Chris Page, Willie Simmons, Chad Altman, Adam Leaphart, Bill Marshall, Tammy Lognion, Casey Moorer, Matthew Lawson

Guests: Julie Holling, Matthew Puckhaber, Lowell Hook, Carl Bussells, Ken Tuck, Jon Morgan, Brian Lynch, Chad Holbrook, Larry McCord, Allan Stack, Ernie Guerry

Location: Spartanburg Water's Pavilion #1, 155 Chigger Creek Rd., Chesnee, SC 29323

Call to Order: 10:08 am 04/08/19

Minutes:

Chairman Chris Page called to order the 131st Meeting of the South Carolina (SC) Aquatic Plant Management Council (APMC or Council). We will have to wait and see if we have any more members of the public. We do have one. Council members, it is going to be much better under Ms. Holling, when she does this. She got you nice little folders that are organized, not just loose papers. The manila envelope was his idea. The packet has some information from the agency, a plant book, and several other things. We are not going to use any of the stuff in here, unless you want to look up some pictures of some of these plants.

Mr. Page noted we have a quorum present. He did not have anyone say they were going to call in. There may have been an email mix up with the SC Department of Parks, Recreation and Tourism (PRT). He was not sure if the new guy is aware he is on the Council, but an email was sent to him and the previous member.

Mr. Page thanked everyone for coming, even though it was a long drive. He likes to move the meeting around the state, so you can see some different places. The year before last, we were up at Paris Mountain. We may go to somewhere near Clemson in the future. The fall meeting will probably be closer to the coast. We may do it in conjunction with the South Carolina Aquatic Plant Management Society (SCAPMS) meeting, so that you will have the opportunity to attend that if you want to. We will talk later about that.

Mr. Page called attention to error on the agenda. He incorrectly put "Draft 2018" plan. It is the "Draft 2019" plan that has been out for public review. Please make a note of that. The minutes are the first thing on the agenda. He gave everyone a few minutes to review those, unless everyone has already read them. Please let me know when you are ready to move on. Mr. Marshall made a motion to accept the minutes. Ms. Moorer seconded the motion. Mr. Page asked if there was any discussion. There being none, he called for a vote. The motion passed unanimously.

Mr. Page moved on to the public comments. This was for anyone who wished to speak and there was one person who asked to speak. He does reserve the right to allow anyone who comes in late a chance to speak, if they wish. He gave the floor to Mr. McCord, after jokingly limiting him to two minutes.

Mr. McCord appreciated the opportunity. Some of you may know him, as he retired from Santee Cooper (S-C). He was loosely representing with the Goat Island Boat Club. They did not have anyone else who could travel this far. He has attended one of their meetings and is in the cue for being accepted as a member. He has discussed that organization and their interests many times before the Council. It is a group of homeowners, lake users, fishermen, and hunters, but mostly lake front homeowners. He said their main interest is that the lakes be maintained with diverse consideration, not giving more importance to a single use group, which may be detrimental to other uses of the lake. Their main interest is being able to use their boats, jet skis, and other water crafts when they want to for a variety of recreational uses. They are also very interested in drinking water as an issue on the S-C system. They feel that the managing of the S-C lakes needs to, first and foremost, look after folks who have a 24-7, 365 interest in what goes on in the system. That includes the water plant, the drinking water intakes, and all recreational activities, with the possible exception of duck hunting, which is only a 5 month or so period when duck season is open. Ducks are migratory birds and do not use the lakes extensively during the off season, except for those that are farm raised and released so we can have residential ducks and geese that we can see all summer. Other than human intervention, they are normally only here when they migrate through in the fall and winter.

Mr. McCord said there has been a lot of interest by duck hunting groups to make changes to the plan. He urged the Council to consider those comments, but not let them drive the decisions on managing the S-C system in particular, but also the other waterbodies of the state. These are man-made reservoirs that were built for specific purposes. Neither duck hunting or fishing were one of the purposes. Hunting, fishing and other recreational activities have grown considerably from the creation of the reservoirs, but there are an awful lot of other issues that need to be considered. In reading the plan, he did officially comment that we need to continue following the 10,000 grass carp stocking numbers that were agreed upon by S-C, SC Department of Natural Resources (DNR), and the Council. Those numbers were not just picked out of the air. They were based on a whole lot of data collection over the years. He knows that some organizations have suggested that be cut in half or come up with some arbitrary number. They need to have an extensive amount of information to back them up before those are considered. Hopefully, any legislators or legislative staff that get involved with helping you make decisions on the plan will be reviewed regarding their interests, information, and background. Just because they make statements that changes should be made to the plan does not mean their voices should carry extra weight because of their position. He understands it can, because we are state agencies, but it should not.

Mr. Page thanked Mr. McCord for his comments and asked if anyone else in the audience wished to speak. No one did, so he moved on to the next agenda item. Mr. Holbrook is here to report of the grass carp population monitoring. You heard some about what he has been doing and his tentative report at the last meeting. He has finished the report for last year, but it is an ongoing study, which will build year after year as long as we have funding and he has the time and is gracious enough to do it. We are going to get as much data as we can on grass carp.

Mr. Holbrook said he is the fisheries coordinator for DNR Region 4, which includes Lakes Marion and Moultrie. He wanted to explain what we do with grass carp, including how

we collect them, what we do with them after collection, what data we record, and how we analyze that data and present it to the Council. With grass carp, the Council has a running population estimate they use. That is one piece of information. Another piece of information is to look at the grass carp and try to determine what kind of condition they are in. We collect them by bow fishing at night in the fall, when they should be in their best condition of the year. They have lived through the summer when the vegetation should be easy to find. Once we collect them, we bring them back to the lab to be weighed and measured. Then we look for an ear bone (otolith) in their skull. The reason we are taking that bone is to try to age those fish. The reason we want to age grass carp is that when grass carp were first stocked in the lakes in the late eighties and early nineties, it was thought that they would live 10-12 years and die. That is not necessarily what we are finding. The longevity of these fish is much greater than we thought. There are a lot of those fish out there from those original stockings. That is something we need to take into consideration when we are using these population models. We need to think about the mortality rates and what these long term fish mean to the system.

Mr. Holbrook talked about the otolith and how it is used to age the fish. It looks like a small pebble, about the size of the end of your pinkie. We mount it to a microscope slide and sand it down to the core, so you can see from the first year of life to the last. We look at it under a microscope with a fiber optic light. As cold blooded animals, grass carp lay down a growth ring every day. When the water is cold, those growth rings pile on top of one another and create opaque sections. When it is warm, the growth rings spread out. You look and count these opaque sections to age the fish. One of the pictures on the slide showed a fish that was about seven years old. The other picture was an older fish. There were a lot of rings there and it gets more complicated. We have two readers that look at otoliths independently of each other. They do not know what age the other reader has assigned to each fish. After they are done, they get together and compare their sheets. The ones they agree on are great. They sit down and look at the ones they do not agree on. They can come to a consensus pretty quickly on the fish that are ten years old or less. When you get into the older ones, we are not concerned about the accuracy once we know they are over twenty years old. It was part of those original stockings and it has survived for a really long time. We group all those fish into a greater than twenty year old group.

Mr. Holbrook discussed this year's collection. We went out five times in October. We were able to get fish from both Lake Marion and Lake Moultrie. The measurements on the screen were in millimeters. To translate that to inches, a 500 mm fish is close to 20 inches and a 1000 mm fish is close to 40 inches. These are big fish. The slide showed the age distribution of the fish. There are a lot of these twenty plus fish still out there. He pointed out the time frame when there was no grass carp stocking, so we are missing those age classes. He noted the areas on the graph when the most recent stockings occurred, as well as the last stockings of 100,000 fish.

Mr. Holbrook spoke next about analyzing the data. We weigh and measure these fish, and use that information to determine their condition. The best way he can relate this is using a fish more people are used to seeing, a large-mouth bass. The slide showed two fish. The one on the left is obviously skinny, so that comes out to a condition less than one. One just means you plug the length of the fish into an equation that gives you the expected weight of the fish. Then

you divide the actual weight by the expected weight. If it is less than one, the fish is skinny. If it is more than one, the fish is fat. For those folks from this area, the fish on the right is from Lake Jocassee. When you are looking at large-mouth bass, the estimated weight equation was created using thousands of fish from all over the state. The average is a true average.

Mr. Holbrook said for grass carp, we do not have that luxury. There have been very few grass carp studies in the state. What we have is a condition factor that was calculated in 1994 by Phil Kirk from the US Army Corps of Engineers (Corps). Grass carp were first stocked in 1989. We had a lot of *Hydrilla* in the late 80s and early 90s. The fish that were used to calculate that equation were big fish. They had a lot to eat. He is not sure if the fish in the slide were the ones used to make the calculation, but these fish were collected by bow fishing in the late 80s or early 90s. It may be hard to see what these fish look like, but these are some rotund fish. That is what the average is based on. He then showed one of the fish collected this past year. Looking at it laid out on the measuring board, it looks big. It is nice and round and fat. It still scores out at less than one on our condition factor. He showed one of the old fish. It has a big head, and is long. There is some research that shows that as grass carp age, their body shape changes. They get less rotund and more torpedo shaped. If you have a bunch of fish out there like this, it is going to pull your average condition factor down.

Mr. Holbrook showed a graph of the condition factor of this year's collection. You have to think about what the 1.0 condition factor actually means. It means that was the average condition of fish in 1994 in S-C when the lakes had 30-40 thousand acres of *Hydrilla*. When we are comparing fish to that, we are not achieving that 1.0 right now. Those are not the conditions in the reservoirs right now, so that is not what we are seeing. The overall condition factor of all the fish was 0.84. If you really want to make an apples to apples comparison and only look at those young fish that are in robust shape, you can look at those fish that are six years old or younger, because that was what was used in 1994. For those fish, we are looking at a 0.88 condition factor.

Mr. Holbrook showed a graph of how condition has fluctuated over the years with the *Hydrilla* present in the system. The dotted line is *Hydrilla* acreage in S-C starting when surveys started around 1994-1995. The solid line with the triangles is the condition factor of grass carp in the reservoirs. Regrettably, we do not have consistent data. We are missing some years. The red line is the median of the condition factor of all the years. He pointed out the two times when the condition was one or more. The first time was in 1994, when it was at one. The second time was in 2012, when it went over one. Those times correlate with what was going on in the system. There was a lot to eat, with a lot of *Hydrilla* growth. When there was not a lot of *Hydrilla*, the condition has gone down. Those peak times, especially the 2012 time, caused the system to be stocked with a couple hundred thousand grass carp. That is not a good situation for the fisheries in S-C, because the grass carp will eat the *Hydrilla*, then move on to native vegetation. From a fisheries biologist perspective, managing for bass, crappie, and other sunfish, those fish need that vegetation out there, and that reduction is not something we want to see. Those real high peaks in condition factor actually make him nervous, more than being glad the fish are in great condition. It means there is a lot to eat and that makes him worry. He asked if there were any questions.

Mr. Page asked if you can somewhat monitor the *Hydrilla* growth in the system by looking at the health of the fish. If we get past a certain stage, those fish are going to become healthier and get to a one condition or higher. Mr. Holbrook said you definitely want to continue to do this for a few years. From a snapshot, it looks like you can correlate those two things pretty well. Mr. Page said this is another tool for us. Mr. Holbrook said this should definitely be used as a tool. Mr. Page said we can use it to help gauge *Hydrilla* growth along with the surveys, and look for those correlations. If we are trending up again, then we may have gone too far down in our carp numbers.

Ms. Moorer asked if the collection methods had been consistent over time. Mr. Holbrook said he knows it has been consistent for the last three years, the original collections, and the late 1990s. He will have to check on the collections from the 2011, 2012, and 2013. Ms. Moorer said she was concerned about both time of year and method of collection (bow fishing, gill net, or electrofishing). Mr. Page said those peaks might be outliers if they were collected at a different time of year or by a different method. Mr. Holbrook said the rest of the fish were collected in the fall of the year when they would be expected to be at their healthiest. He did not know about the 2011-2013 collections, but would look up that information and provide it to the Council.

Mr. Simmons asked if Mr. Holbrook and his staff were doing the collections themselves. Mr. Holbrook said no, they are going out with a hired guide. Mr. Page said the money to hire the guide is coming out of the Aquatic Nuisance Species (ANS) program funding. S-C supplements them on the otolith work. Ms. Moorer said they had not done that in several years. Mr. Page said we might be able to provide a little more money. Ms. Moorer there has been some additional discussion with Mr. Holbrook, Clemson University and Dr. Troy Farmer about doing some additional research and S-C trying to fund some of that.

Mr. Page said that if you look at the report sent to you before the meeting and included in the paperwork today, a lot of the information in it came from the early studies by Phil Kirk. Virginia Tech has done a study on inland lakes that changed the percent mortality rate of carp in inland lakes, which are more similar to Lake Murray than the S-C lakes. It is less likely that those fish are going to get depleted in Lake Murray, Lake Keowee, and other inland lakes as they are in the S-C lakes, where there is more predation. There is a lot of good data out there that we have looked at over the years. Mr. Holbrook said that one of the things we would like to work with Clemson on is related to Virginia Tech's use of a biomass model that took into account the older fish in the system. The older fish may not grow at the same rate as the younger fish, but may weigh 30 pounds and still have to maintain that weight. They have to eat a lot to maintain that weight. They factored into their biomass model the importance of these older fish in contributing to the control of *Hydrilla* in the system. Mr. Page commented on Clemson's lack of research on wildlife and fisheries for a while, but that has been improving, with them asking DNR what we needed done. He has been to some of the waterfowl workshops and they were very interesting and shed new light on a lot of things.

Mr. Simmons asked if Clemson has mentioned an amount for the survey they are talking about. Ms. Moorer said they have not. We have asked for an outline of what they want to do and what we can afford to fund. That research data would be beneficial to S-C for our

management, so we definitely want to contribute as much as we can. Mr. Simmons asked to be included in future conversations about that. Mr. Holbrook was hopeful that would happen pretty soon. Mr. Page said that might be something that SCAPMS might be interested in funding. Mr. Marshall asked what research Clemson was wanting to do. Mr. Holbrook said it has not been nailed down yet, but we put out a bullet list of questions that are important. One of those was re-evaluating the mortality rate for the population estimate. Another was doing some telemetry work to determine where the fish go once we stock them. That was done with some of the initial stockings, but we would like to repeat some of that work to determine if there are more beneficial places to stock the fish. There are questions about immigration. Because the S-C system is so open with the lock and the spillage at the Santee Dam, we really do not know how many fish we lose each year. If you have enough telemetry transmitters, you might be able to figure out some numbers. It might change each year based on whether there was any flooding. He said Dr. Farmer was interested in looking at the variable consumption rates in young versus old fish. That is a really hard question to get at. It is really easy to buy a young fish and put it in a pond, but really hard to buy an old fish to put in a pond. We were toying with ways to collect some old fish, but there is no way to know if they are old without pulling their otoliths and killing them. We will have to work through some of that. Dr. Farmer was talking about contacting some of the aquaculture farmers and seeing if they have some brood fish that are ready to cycle out and using those. We have some ideas, and hopefully it will move forward.

Mr. Page said Sam Chappelear is the one that did the original telemetry study during his master's studies. He asked if there has been any information coming out of the University of Georgia (UGA) or the Corps about the telemetry study they did on Strom Thurmond Lake. Their first step was to do telemetry studies on several thousand fish they stocked. Ms. Moorer asked Mr. Holbrook for his opinion, from a fisheries standpoint, on some of the public comments that said the data showed the grass carp were grossly underweight. She thinks his explanation of the condition factor and what it is based on was very useful. She asked if it was his professional opinion that the grass carp are underweight or malnourished. Mr. Holbrook said no, they are not.

Mr. Page understood that Mr. Holbrook said we really cannot tell what number we are looking at to be a perfectly healthy fish because of the aberrations in the way we collected data in the early years, when they were stocking in age groups, and the amount of *Hydrilla* present. Mr. Holbrook said ideally, we would have a data set that spanned eight to ten years and included more than one lake, where we could say what an average fish in SC looks like. Then we could compare those fish to that average. We do not have that. We have a sample of fish from the most premium condition time that ever existed in the S-C system for grass carp. We try to make comparisons back to that. Mr. Page said we have a snapshot in time. We do not have good, consistent data. He hoped that Mr. Holbrook will have the time to continue working on this study. We would like to continue it as an agency. He knows it is a pain for Mr. Holbrook. Mr. Holbrook said it is interesting and worthwhile to track that condition factor to see if it does play out and is as useful a tool for management as we would like it to be. Ms. Moorer said it is an important tool for us, but we need have the data and understand how that condition factor was derived. It is important for the Council to understand that, too. Mr. Page said that median line on the graph helps you see how this levels out just based on limited data. He explained the difference between median and average or mean. The more data we have, the closer the median gets to the mean.

Mr. McCord commented that in the slide from the 1990s, those fish were probably collected after some period of overstocking, because there were not any smaller, just stocked, fish. He does not know what they did to make sure that fish were collected randomly, but those fish all looked almost the same size. They were all very large. All the fish in the system were not the same size, even at that time. As years have gone by, the fish collection methods have changed some, even though a lot of it is still being done by bow and arrow, and electrofishing. He asked Mr. Holbrook what he is doing to ensure you are targeting the variety of fish that are in the system. Recently, with all the data you have been collecting, we have been continuing to stock fish, so there are different age classes in the system. He asked if fish from all those different age classes were being collected. Even with electrofishing, he asked if you are more likely to collect larger fish.

Mr. Holbrook said he has some heartburn about the true randomness of the sample we are collecting. The thing that makes him think about it most is the large number of older fish and whether that is a true representation of what is actually out there or is it that those older fish are more lethargic and easier to hit with a bow and arrow. We did have to get the guides to understand that we are not trophy fishing. A small fish is just as important as a thirty pound fish. We get excited when they shoot a small fish, so they know it is important. This year, we came across five or six fish that appeared to be from this year's stocking. They were less than 16 inches long. It is hard to hit one of those fish with a bow and arrow. The true randomness of the sample when you are using this selective gear concerns him a little, in comparison to putting out a gill net, which provides a truly random sample. Electrofishing is usually more effective on larger fish than the smaller fish because you have more surface area to hit. All the grass carp studies so far have dealt with these same issues. It is usually spelled out in the methodology and in the discussion part of the published literature. They describe how they made the collections and understand that there are some problems with the true randomness, but to their knowledge, this is the best way they can do it right now, so this is what we deal with.

Mr. McCord commented that the randomness is an issue, but this is not a perfect world, so you are not going to be perfectly random. The issue is this data is being discussed and misconstrued. People are getting the idea that the fish are not at ideal health, so that means there is not much vegetation out there, and we should remove some of the fish so more vegetation can grow. That is a very slippery slope. Your data is not saying that definitively yet, so you need to collect more data. The only point he argued is the idea of collecting from other lake systems in the state may not be a good idea. Historically, we know that the grass carp in the S-C system do not necessarily behave like the ones in other systems. The age, for instance, seems to be much longer than in other systems. That may be because we do not have data from other systems. He thinks that data used to make decisions on the S-C system should mostly come from the S-C system, in the event that there is a lot of difference from other systems. That is where data analysis would come into play.

Mr. Holbrook said we do not have that issue right now, as this is the only place we are collecting data. For the foreseeable future, he does not expect to collect from other locations. Mr. McCord said it is very important that it continues, because that is important information. Mr. Holbrook asked if there were any other questions.

Ms. Moorer and Mr. Page thanked Mr. Holbrook for the presentation. Mr. Page looked forward to DNR and S-C working with him in the future. Mr. Page asked Mr. Lawson, from PRT to introduce himself. Mr. Lawson did so, apologized for being late and let everyone know that he is the new Chief Resources Manager for the park system. He went to quite a few Spartanburg Waterworks locations. Mr. Page called on Ms. Moorer to make her presentation.

Ms. Moorer said this is basically the same presentation she made at the last Council meeting, so Ms. Lognion and Mr. Lawson will see it for the first time, while Mr. Marshall will get the visual he missed before. This first slide is a quick summary of what we did in 2018 in the aquatic plant control program at S-C. Our program is mainly driven by invasive plant control. We do a minimal amount of residential and commercial work on native species, mainly for water access. We were down last year on crested floating heart (CFH) from a little over 500. At one point, we had over 6000 acres of CFH on the system. We are kind of winning that battle, but Mother Nature helped us out and we got a new herbicide that is active on it. The giant salvinia acreage you see is acres of treated salvinia. That does not mean 145 acres of solid salvinia. A lot of that acreage was mixed in with water hyacinth that we were targeting. Luckily, the herbicide we were using was active on both species, and so we could take out both hyacinth and salvinia with the same mixture. Just know that acreage number is not solid salvinia acres.

Ms. Moorer said we had over 500 acres of *Hydrilla* identified at the previous aerial survey with Galileo using hyperspectral imagery in 2017. We treated 119 acres using ProcellaCOR, the new herbicide. It is a very selective, systemic herbicide that will take out the *Hydrilla*, but leave *Vallisneria* (val), pondweed, naiads and other beneficial natives that we want to keep on the system. We had very successful treatments. We just went back in February and checked those locations. We did not find any *Hydrilla*, but we did find bacopa, val and some naiads, which is great. That is what the goal is here.

Ms. Moorer said the water hyacinth treatment of a little over 1000 acres was down from the 2000 acres treated last year. We got a little ahead of the water hyacinth. We treated a total of a little over 1800 acres of just invasives on the S-C system. She wanted the Council to understand that we have four very aggressive invasive plants on the S-C system and we have very limited resources, both in budget and in man power. Everything we do, we are focusing on the invasives. We have these tools in our basket, including grass carp, which we like to have at our disposal to make good management choices.

Ms. Moorer noted the next few slides focus on the *Hydrilla*, since that has been the main topic of the S-C system, and the reason for the recommendation of 10,000 carp we gave the Council at the last meeting. The red dots on the northern shore of Lake Moultrie and the northern shore of lower Lake Marion indicate stands of *Hydrilla*, not acreage that we found in 2016. In 2017, these are actual polygons in Upper Marion, Taw Caw Creek, and Potato Creek impoundment. Potato Creek was topped out, but it is not included in our acreage. We do not include impoundments that are completely closed off from the lake in our total acreage. Upper Marion picked up, and there were also locations on the south side of lower Marion that were not there in 2016. The distribution expanded as well. In 2018, we did not fly because of Hurricane Florence. We had high water and high turbidity, which are not ideal conditions. We would not

have gotten good data for what we would have invested in that imagery. We did do some ground survey work, up until March. You see that it spread across Moultrie, and we picked up some more areas on Moultrie. The distribution has spread and the acreage has increased. We went from 200+ to 568 acres. That has been the last two years, when we have stocked 10,000 grass carp.

Ms. Moorer said the next few slides are just to show you what we are seeing. We did have a very mild winter. We were hoping for a long, cold winter, like last year, to kind of get some help from Mother Nature with the salvinia. We did not get that, but it was kind of good for our native vegetation. She showed a slide of Russellville Flats. Everywhere we were throwing rakes, we were pulling up some good native vegetation mostly, including bacopa, milfoil, and naiads. When you take a closer look, there was some *Hydrilla* mixed in there. We also found some elodea in Lake Moultrie, which we have not found in a long time. That was in upper Marion. It was actually her first time, in 12 years or so, seeing elodea on Lake Moultrie, but there was also milfoil, pondweed, bacopa, and other good natives. We also saw some val, which is good for February, but there was some *Hydrilla* mixed in there. Everywhere we are throwing a rake, we are seeing the natives take off, but that is the fear right now.

Ms. Moorer noted that is where we were when we got stopped from stocking. Our native vegetation was doing great and recovering. Everywhere we were throwing a rake, we were getting a sprout of *Hydrilla* here and there. We were stopped from stocking. Before you knew it, we had 7000 acres of *Hydrilla* on the system. That is when we stocked 109,000 fish one year and 100,000 fish the following year, early in the season. That is what Mr. Holbrook was talking about not being good for the system. He does not want to see that, and no one on the S-C staff wants to see large numbers of fish being stocked again. Her concern is for the Council not to take the tool of the grass carp away by lowering the stocking rate or taking it away completely.

Ms. Moorer said there has been lots of discussion about being conservative. To her, 10,000 carp is conservative. That is what was agreed to before she was put on the Council. We are in the third year of stocking 10,000 fish. That is conservative, compared to what we have done in the past. We do not want to get to where we have to stock 100,000 fish again. We do not want to repeat that history. She feels that, based on the data from Mr. Holbrook and the S-C staff, we are nearing the place where we need to think about replacing mortality. As a Council, we decided to stock 10,000 fish per year for five consecutive years to slow that curve down and see where we are at. We do not want to chase that curve. *Hydrilla* took off and we stocked large numbers of grass carp to chase it. After the *Hydrilla* dropped off, the grass carp population started coming down, too. Then we stopped stocking, which dropped the population faster. It also impacted the age classes, which affects how the grass carp help us manage *Hydrilla* on the system.

Ms. Moorer moved on to images of other areas. The first was on upper Marion at Coca-Cola Slough. This was one of the original sites where we found giant salvinia on the system, so we hit this area hard last year for salvinia. She wanted to show that because when we are using the right chemical, we are having some selectivity there and are not damaging our native vegetation. The next slide was a picture of salvinia on the system. This is March. Obviously, we had a good population overwinter. We did not have consecutively cold months, weeks or

days at all this year. Last week, we sprayed over 100 acres of salvinia. A lady called her fussing about the spraying, but we had a reason to spray.

Ms. Moorer reminded the Council that a few years ago S-C teamed up with DNR and some waterfowl groups to target giant cutgrass in the system and open up some potholes for duck hunting. This is Bee Tree Lake Cut on upper Marion. We opened this up. We did aerial work for two years and then some touchup work with airboats. All this area was open water, and now it is all salvinia. That is one of the areas we treated last week.

Ms. Moorer moved back to the *Hydrilla* and carp numbers. She wanted to make the point that we do not want to take away the tool of grass carp. We are nearing that place where we need to be replacing mortality, which would be somewhere between 12 and 14 thousand fish on the system. Right now, she feels comfortable with the 10,000 fish we have in the plan. Next year, we will have to take a hard look at where we are. We may be to the point where we start stocking mortality. She reiterated that we do not want to chase the *Hydrilla* and pointed out on the graph where that occurred before. The stocking of 10,000 per year has slowed the reduction of the carp population, so we do not have to make knee jerk management decisions. We should be at about 36,000 fish on the system this year. The stocking of 10,000 fish does not even replace the mortality. To prepare the Council, she thinks it is likely that we may need to stock more fish next year. We will be able to better determine that as we do more surveys, including the Galileo hyperspectral survey we hope to run in the fall if there are no hurricanes or other flood events that delay or cancel it. She asked if there were any questions.

Mr. Page said he has always liked that graph. It shows him that in the mid-2000s, we did not have younger age class fish. We had significantly reduced age classes. In the vicinity of 20-30 thousand fish, the *Hydrilla* took off. We are looking at the same thing coming up. As Ms. Moorer said, we are not doing a mortality stocking right now. We are stocking between 2-4 thousand fish below that. You are looking at 30-40 percent more fish into the equation. It does not bother him as much now that the *Hydrilla* acreage has increased over the last couple years, because he knows we have various age classes of fish. Also, in the past, we were having to use contact herbicides. Most of the systemic herbicides we tried to use were not very effective because of the flow in the S-C system. With the new product, he thinks we can target those a little better and get more effective results.

Ms. Moorer said to think about it from a resource standpoint. In 2005, CFH showed up on the system. The 2008-2009 time frame is when we had almost 5000 acres on the system. Our staff consists of four people. Our resources are a big concern when it comes to invasive plant management.

Mr. Page thinks we are on the right track but are going to have to consider maintenance stocking. We are somewhere between 1 fish for every 4 surface acres (1:4) and 1 fish for every 5 surface acres (1:5). The current number is about 1 fish for every 4.7 acres. Most of the literature originally called for 1:8, but that was in Piedmont type reservoirs. We looked at ratios of 1:6, 1:5, and 1:4. That is the same process we are following right now in Lake Murray and Lake Greenwood. In Lake Greenwood, when we dipped below that number, we had *Hydrilla* come back. When we are above that number, we are not seeing much *Hydrilla*. Anything above 1 fish

per 6 surface acres is probably going to be effective, but where that number is may fluctuate from year to year based on Mother Nature. As Mr. Holbrook pointed out earlier, we cannot tell you exactly how many fish are out there. We can model it out, but the model is only as good as the data. He asked how many fish we lose in a hurricane event where that system flushes or gets flooded or there are high flows. During those events, the locks get opened and stay open for a much longer period than they usually do. That happened in Lake Murray. We pretty much had to start over with a maintenance stocking. We had reports of hundreds, if not thousands, of dead grass carp just down below the dam in the parking lot of the Saluda Shoals Park. If that was how many we counted, how many were actually lost? It is a tool.

Mr. Page said grass carp average out to about $10 per year per acre. You tell me what else you can go treat for $10 per year per acre. The cheapest herbicide we use is probably $110 per acre per year. The more effective herbicides are getting up to $150-160. There are even some herbicide applications we do on other species that cost $600-800 per acre. We can do things to cut cost and be more efficient by doing integrated management. We are trying to use all the tools available to be able to do something in a more efficient, more concise, orderly manner while not affecting native species any more than we have to.

Ms. Moorer was not sure where the 5000 carp figure in the public comments came from, other than it cuts our number in half. She asked if Mr. Holbrook or Mr. Bussells had anything to add. Mr. Bussells noted that in the late 80s, there were about 38,000 acres of *Hydrilla* on the system. By the mid-90s, there were about 300,000 carp in the system. About 750,000 carp have been stocked. If you look at our management, where we are beginning to replace mortality, that number is a drop in the bucket compared to what has been stocked in the system. He thinks a lot of people who are not familiar with this data, or educated on it, think 10,000 carp in the system is a huge number, but compared to 750,000, that is not a big number. Mr. Page said that is why he always tries to put out the 1:4 fish per acre ratio. It makes Mr. Holbrook's job harder to go find them, but most of the time, they are schooled up. If we had one strand of *Hydrilla* for every 4 surface acres, we would not be having this discussion.

Mr. McCord, after being given the floor, said you should be very careful about assuming you can control *Hydrilla* with the new herbicide. It is considerably more expensive than stocking grass carp. It is also a chemical application to a drinking water reservoir as opposed to a biological control. That should be considered. A lot of time, we forget about that. The 10,000 fish currently being stocked is less than 1 fish per 10 acres that you are putting in the system. That is like having a 10 acres pond full of vegetation and putting one fish in it. It will do nothing to control vegetation in that pond. Ms. Moorer does not think anyone's intent is to run a chemical based program or a grass carp based program. The intent is to run a truly integrated management program and use all those tools and not rely heavily on either grass carp or herbicides.

Mr. Page said when S-C was first stocked, it was the cutting edge for large reservoir management of an invasive species, like *Hydrilla*, with a biological control. Grass carp were one of the first biological controls that was deemed to be effective in the United States. Now, we are on the cutting edge of figuring out how to maintain that with limited numbers of carp. Although people have done some research, they did not have the background of doing the original

stockings or have a system that has been infested with *Hydrilla* for as long as we have. We have the petri dish. It behooves us to take science and let the science get that information for us. The integrated approach, being able to do this long term, and having Mr. Holbrook around to continue to study carp is important. Hopefully, Mr. Holbrook will continue to get funding and he has the time and the blessing of his superiors to do it. Mr. Page thinks we are on the right track. We just need to stay the course and do what we need to do.

Mr. Page thanked Ms. Moorer for the presentation. He also thanked Mr. Holbrook for everything he has done. It is also integrated in the fact that we are all working together. There has been a time when we all did not pull the same direction on the rope.

Mr. Page moved onto the draft plan. He reminded everyone to correct the date on the agenda to 2019. The comments on the plan are in your folder. He wanted to go over the comments. The very first one is the one we got the most of. There were 80 of those. It was a cut and paste response where you filled your name in and sent it in. We have addressed several of the issues they had. They are talking about factual, scientific data. We all know that the fish and waterfowl need vegetation for their health and survival. The third paragraph addresses the poor health of the carp. He thinks that goes outside the realm of scientific information. Ms. Moorer said that was why she asked Mr. Holbrook that final question. Mr. Page said that is why we have had him doing this study. He does not think Mr. Holbrook can necessarily agree with that statement, because he wants more data. He thinks the information we have gotten from the scientific study has disproven their statement.

Mr. Page went to the three requests. The first request was reducing the 10,000 carp to 5,000. In the list of senders, you will see a few places where there are parentheses with a number after their name. Some people changed that number to 3000 or zero. That was the easiest way to present that information to you. If anyone wants all the original emails, he can send them to you. A few people went a little outside the box and wrote some different things, mostly regarding the carp. The second and third requests are regarding putting grass carp in waterfowl impoundments in the Hatchery. He skipped to the third request, because that was a weird one. There were some ponds that were adjacent to the lake, and because of the high water and flooding had retained water. They were full of *Hydrilla*. It was suggested that they be stocked with 15 fish per acre in those ponds. Since that time, those ponds have dried up. There is no direct link to the lake, so they do not pose the threat they did. That was a remnant in the plan and has been taken out. On the second request regarding Potato Creek, we had that in there in case we needed it and we stocked last year. There is no need to put any more grass carp in there. We have good control in there and S-C graciously fixed all the gates that prevent the carp from escaping. He took both sections out of the plan. He gave them two of the four things they wanted. The fourth thing being the triploid grass carp. We basically told them they are misinterpreting the data. The only big thing here now is the 10,000 grass carp. He hopes that by some of the stuff we have learned, you understand why we want to stock that number.

Mr. Page said some of the comments talk about native submersed aquatic vegetation (SAV). He is currently working with S-C and our fisheries biologists in the upstate to harvest some *Vallisneria* that otherwise is going to be killed in Lake Greenwood. It is a highly developed residential area where boat traffic in a small, thin cove is extremely restricted. It

breaks his heart have to try to do anything to it, but if we can move it out, that would be great. It is a readily accessible area, and we might be able to transplant some of this to S-C. It is going to come down to man-power and time. Ms. Moorer said S-C has set aside some money for native revegetation of some areas, including button bush, *Vallisneria*, and a few other species.

Mr. Page noted there were a few comments regarding Lake Greenwood. They do not want anything done to hurt the val. He does not think that is a reasonable expectation, because we do have multiple uses that we need to worry about. Mr. Marshall asked if the collection of val was open to volunteers. He has heard from some groups that want to volunteer to help with native plant enhancement. Ms. Moorer said that is something we talked about. The issue we have on Lake Greenwood is that there is some *Hydrilla* mixed in with the val. We already have enough on the system. We do not want to help it out. We talked about getting some volunteer forces together, just as long as S-C or DNR staff are present to help go through that. It may be that they collect it, we go through it, and then they help us put it out. Mr. Marshall asked about the time frame. Ms. Moorer said spring and summer. They have some time set aside to go see Ms. Davis at Greenwood. Mr. Marshall said he would connect with the folks that mentioned it and find out if they are still interested.

Mr. Page said there were also some comments about Lake Murray regarding the number of grass carp we are planning on stocking, which is 1800 fish. That is the maintenance stocking level. We have yet to have a situation where *Hydrilla* has popped back up. We are going to continue where we are. Lake Murray has actually had a diverse assemblage of native plants come up out there. They are problematic to some degree, but the people think they are more problematic than they actually are. They are getting too upset over the fact that there is southern naiad and Illinois pondweed ringing some of those areas. The only problem he sees is with it is jet skis. Boats can travel through those plants fairly easily and kick it off pretty easy. The drawdown last year will probably help some of that in the swimming areas. There have been several people out there that were starting to get algae blooms in the shallow parts of their swimming areas because of a buildup of detritus. The drawdown should have helped that by packing the sediment. Some people took advantage of that to get stuff out of there. They actually went out with rakes or dredged the area some and replaced it with sand. That was all in the SCE&G's purview at the time. Now it belongs to Dominion. He asked if there were any questions about the comments.

Mr. Page said there is a printout in your folders where he broke out some of the problem areas. In Lake Bowen, they are having some problems with bladderwort. They have some other problems you are going to hear about later. If you live around any drinking water supply reservoirs, they may have some of these problems, too. The issues are ones that may be facing most of the people around this table and the managers of those reservoirs.

Mr. Page back-tracked to the public comments, as his response is on the last two pages of that document. It was directed more to the S-C system, but also included Lake Greenwood and Lake Murray. Some of the people on Greenwood wanted *Vallisneria* removed from the nuisance list, but it is not on the state's aquatic invasive list. It is a nuisance at times. We list them as nuisance species in the plan, but there is no nuisance list. It is native to the state of SC. Illinois pondweed is not. It was found in some very shallow areas of Lake Murray and the drawdown

probably damaged it severely. One of the things the Council needs to consider in the future, fisheries biologists will tell you that fluctuation of a lake system periodically is good for the dynamics of fish. It is very good for spawning activities after that. For waterfowl, it has the same effect. Mr. Holbrook said it is good as long as it is done at the right time of year. Mr. Page said it needs to be done in the winter and then get it back up in time for spawning, which creates better spawning resources.

Mr. Page directed everyone back to the plan modifications. It kind of goes into the rest of the stuff. He asked if there were any questions or comments on the response. There were none. He asked if there were any questions or comments on the modifications to the plan. He gave everyone a minute to read those again. He said they could look at the document and see where he has taken things out. It is easier to work with some of these sections that are contested than bring you a 200 page plan every time we meet. Some of those things have been in there for years. We still do work, but we have never had comments about it. He noted that the whole plan can be pulled up on the projector, if needed.

Mr. Page noted that diquat is still listed in the plan. Technically, the current label is not allowing it to be used in submersed applications on drinking water supply reservoirs. The set-back registration on it has been removed. He has sent a letter to Syngenta for a 24-C special local needs permit to allow us to have a setback restriction. That setback restriction will probably be increased from the previous 1600 feet to 1800 feet, based on what has been approved in several other states in the southeast. Syngenta will send information to Dr. Drake at Clemson University. It is normally a straight forward process if the label is right. Ms. Lognion said the documentation needs to be there to support it. You have that, so it should not be an issue. She asked if he knew where it was in the process. Mr. Page said it is just being worked on by Syngenta. He just sent the letter to Dr. Drake to Syngenta, so they can attach it to their package. They make Tribune, which is one of the cheapest brands of diquat made by a major manufacturer. It is a strange label, because part of the drinking water treatment usually includes a charcoal filter, which will remove any remnants of diquat. It gets tied up if you use it submersed in water that has high levels of sediment and it will not be effective on the plants.

Ms. Lognion said Clemson is seeing a lot of label changes coming in for herbicides, not just in the aquatic arena, but also in the agriculture arena. The US Environmental Protection Agency (EPA) is looking at labels and changing things. Mr. Page said the manufacturers have to update their data to the EPA to get in continuously approved at a certain level. That is the EPA's latest response is to bend over backwards trying to relieve complaints about drinking water problems in the US, because that is getting so much news coverage. It is typical of government to have a knee-jerk reaction. He hopes the Council takes the opportunity to look at all the information that has been presented. We are trying to be proactive. That is hard for government entities to do.

Ms. Moorer made a motion to accept the plan as written with the modifications to the Potato Creek and Hatchery WMAs. Mr. Simmons seconded the motion. Mr. Page asked if there was any discussion or any other questions that needed to be answered. He called for a vote. The motion passed unanimously.

Mr. Page introduced Ken Tuck from Spartanburg Water. He graciously gave us the building for our meeting today. He has had his own issues with algae, geosmins, and taste and odor problems. No one likes brown water or water that tastes or smells bad.

Mr. Tuck appreciated the opportunity to talk with the Council today. He probably has a different perspective from what the Council typically hears. He was going to talk a little about aquatic nuisance species and impacts to the drinking water treatment, in both the past and the present. Then we may see changes in the future, on the regulatory front, which may drive the way the management decisions are made about water treatment across the country. Some of the historic and ongoing aquatic issues we are dealing with come from the population growth and development we are seeing in the watershed. That trend is expected to continue exponentially in the Greenville-Spartanburg area for at least the next twenty years. It is very important that we manage our resources and work with other agencies on multi-jurisdictional projects.

Mr. Tuck said the things we are seeing and will continue to see are nutrient loadings into our drinking water reservoirs that cause algae and diatom blooms. Those may cause taste and odor issues that we have to deal with. Historically, we have had some *Hydrilla* on the system in the 1980's, and stocked some grass carp. More recently, we had some issues with musk-grass and bladderwort, which can impact recreation as well as cause taste and odor issues. Several studies have shown a symbiotic relationship between bladderwort and a blue-green algae, which does not cause any problems unless the bladderwort dies in large quantities. At that point, geosmins and methylisoborneol (MIBs) are released into the water column. Bladderwort has migrated down to Reservoir 1, which is closer to the drinking water treatment intake. Reservoir 1 has not been stocked with grass carp, but will be this year.

Mr. Tuck moved on to discuss the various things that impact the water treatment process, including increased eutrophication of the lakes due to nutrient loading, total organic carbon that can increase disinfection byproducts, and taste and odor issues. We have to use all of the tools in our toolbox to manage all these issues and more to ensure a quality product is going to our customers. There has been a considerable increase in cost from managing for aesthetic issues, in addition to the regulatory issues.

Mr. Tuck said they have done a variety of studies with US Geological Survey (USGS) to determine what is going on in the reservoirs and how to manage for them. Some engineering studies were also done to determine the best ways to manage for various issues both within the reservoirs and the water treatment plant. In 2016, a hybrid oxygenation system was installed to help create a sediment cap on the bottom of the lakes to decrease the nutrients available to the blue green algae and hopefully reduce the taste and odor events.

Mr. Tuck spoke about how they manage to deal with the various issues. He noted that they do try to start with the simplest and most cost effective solutions before moving to the more expensive options. They do have some capital improvements planned, deploying some of the newer technology. He also described the various ways geosmins and MIBs are produced. Those compounds and others are being monitored continuously throughout the water column at various locations around the lakes. The extra water monitoring and treatment needed when there are spikes in taste and odor compounds is expensive. The water monitoring also includes

unregulated contaminants for the EPA. The data from that monitoring helps the EPA determine if those contaminants need a health effects study. If that study shows an issue from a public health protection perspective, it will eventually become a regulated contaminant. That may change how we manage the aquatic species and the water resources.

Mr. Tuck reviewed the capital improvement projects that have been completed, are in progress, or have secured funding for completion. The oxygenation system was about a $4.1 million system installed on both reservoir lakes. A new, multi-level water intake line is the first step in getting other improvements done. In hopes of reducing some of the water management we have to do, we have finished a watershed based plan that was approved by the SC Department of Health and Environmental Control (DHEC) last year. We are hoping to work with other agencies and groups to get some funding to implement best management practices within the watershed.

Mr. Tuck gave some basic information about the oxygenation system as a preparation for those folks that wanted to take the tour of the facility just down the hill. There were a few questions and some additional discussion regarding lake size, algae speciation, and taste and odor compound panels.

Mr. Page thanked Mr. Tuck and noted that this ties into what we do. It is important to managers who have to know what is going on in their system, if it is drinking water supply system. There are very few lakes and reservoirs in the state that are not drinking water supply systems and a few rivers are, too. The applicators have to think about those things, too. S-C does not have to think about it as much because you are ten miles away from the intake. Ms. Moorer noted S-C has to think about the intakes that are below them, too. Mr. Page said the Charleston Public Works intake in Back River has had an increase in issues.

Mr. Page said that in the management applications, we have used a product called Phoslock, which locks the nutrients in the bottom layer, but you are not eliminating them. If a high flow event occurs and breaks the bond or disturbs the sediment cap, those nutrients are available again. Other options include hydro-dredging, which is expensive and difficult to do, and bacteria applications to control the nutrient load. Some managers are being more proactive in putting those things out. The Phoslock and bacterial treatments are expensive, but they are still more cost effective than treating the water. He thought it was important to let Mr. Tuck talk to the Council about his work, and how all the parts of the ecosystem interact.

Mr. Page asked if anyone had any more business for the Council. There was none. He reminded everyone that Mr. Tuck has been gracious enough to take anyone who is interested on a short field trip of the oxygenation system after we adjourn. Just let him know you if want to go.

Mr. Page moved on to the next Council meeting date. He noted that we sometimes try to have one in July or August, although that fell through last year. Those are usually field trips, so you can see some of these areas. Ms. Moorer said S-C would be willing to host something, so you can get out on the system. Mr. Page said that he would really like to do is have a meeting in conjunction with the SCAPMS's annual conference, which will be held October 2-4. We start

on Wednesday at 1:00 and end on Friday at 1:00. The hotel is reasonable. You will see presentations on a wide variety of things and it varies from year to year. Included in the meeting is one banquet and a reception, with free adult beverages for a period of time each night. You will get to know some of the folks in the industry. Students from both Clemson and North Carolina State are there, have done a variety of research projects and make presentations. He would like to have the Council meeting either on Tuesday afternoon, before the conference starts, or on Wednesday morning. He would like for the Council to be exposed to that group and what they do. For some of you, it will help with your job. In addition, on Thursday afternoon, there are a couple optional activities, possibly a workshop of some type, a golf tournament, or a fishing tournament. Some of those require an additional fee, which goes back into the scholarship fund. He briefly explained how the scholarship money is distributed.

Mr. Page asked again if there was any more business for the Council. There being none, he asked for a motion to adjourn. Ms. Moorer made a motion. Mr. Altman seconded the motion. Mr. Page called for a vote, which passed unanimously. The meeting adjourned at 12:21pm.